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Contributions to the knowledge of North American Sphagna. I.

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During the past ten years the North American peat-mosses have been repeatedly elaborated. In the year 1882 appeared a work by Lindberg under the title, Europas och Nord-Amerikas Hvitmossor (Sphagna), in which he describes 21 species and 3 subspecies for both continents. Of these *S. cyclophyllum* Sulliv., *S. macrophyllum* Bernh., *S. cribrosum* Lindb., *nov. sp.*, and *S. Portoricense* Hpe. belong exclusively to North America, *S. Angstræmii* Hartm. only to Europe, while the remaining species are common to both continents. Three years later (1885) Miss Clara E. Cummings published in a catalogue of the Musci and Hepaticæ of North America north of Mexico 27 species of Sphagnum. Among these *S. Muelleri* Schpr. and *S. molle* Sulliv., *S. sedoides* Brid. and *S. Pylaiei* Brid., *S. rigidum* Schpr. and *S. Garberi* Lesq. & James are identical, wherefore only 24 species remain. Finally, in Révision des Sphaignes de l'Amerique du Nord (1887), Jules Cardot admits 16 species; the following species, *S. medium* Limpr., *S. papillosum* Lindb., *S. Austini* Sulliv.; *S. affine* Ren. et Card., *S. laricinum* Spruce, *S. squarrosum* Pers., *S. Girgensohnii* Russ. and *S. cuspidatum* Ehrh., are considered by him as subspecies. Cardot seems perfectly justified when he designates the *S. cribrosum* Lindb. as *S. Floridanum* (Austin), for this fine, characteristic species was distinguished in 1880 by Austin as *S. macrophyllum* var. *Floridanum*. Cardot had not seen *S. Garberi* Lesq. & James, but conjectured that it might be only a form of *S. rigidum* Schpr. A specimen which I have received from the Kew Herb. (England) has fully confirmed this opinion of Cardot; S. Garberi is only a squarrose form of *S. compactum* DC.

When now I attempt in the following pages to present a review of all the known species and varieties of the North American peat-mosses, I wish to state that the chief inducement to do this comes from Mr. Edwin Faxon, of Boston. He has during the past year, and even earlier, with unwearied industry and commendable perseverance, made a systematic collection of the Sphagna of Massachusetts and

New Hampshire particularly, and has had the kindness to send to me about 500 numbered specimens. Among these are several new species of the Acutifolium group, which have been recently established by Prof. Russow or by myself, respectively, or by us jointly. In order to make these known among North American bryologists I shall fully describe them in the following pages. Furthermore, in Mr. Faxon's collections are found numerous specimens of *S. affine* Ren. et Card. whereby I am enabled to make perfectly clear the position of this species in the system.

I. Sphagna acutifolia.

A. *Stem leaves with completely resorbed cell-membranes in the upper part.*

a. Stem leaves widening upward, spatulate, the apex and a part of the upper margins lacerate-fringed.

1. *S. fimbriatum* WILS. in Hooker Fl. Antarct. p. 398 (1847).

Syn.: *S. subulatum* Bruch in Herb. Kew.

Of this species I have hitherto seen from N. America two forms:

Var. *tenue* GRAVET. Tufts usually loose, green or whitish-green; plants graceful and slim, with long slender spreading branches.—Mass., Boston and Brookline, 100 feet; N. Hampshire, White mountains, 2,000 feet (*Faxon*); Miquelon Island (*Delamare*); N. Jersey (*White*); Cal., Sierra Nevada (*Brewer*).

Var. *arcticum* C. JENSEN. In firm compact whitish tufts. Stem with short, thick-set, ascending to upright, stouter branches.—Greenland: Mission station, New Herrenhut (*Spindler*).

b. Stem-leaves not widening upward, linguiform, and only at the at the broad, rounded apex lacerate-fringed.

2. *S. Girgensohnii* RUSS. Beitr. p. 46 (1865).

Syn.: *S. acutifolium ε tenue* Bryol. Germ. I. p. 22 (1823).
S. fimbriatum, var. *majus* A. Braun in Herb.
S. fimbriatum, var. *strictum* Lindb. Torfm. byggn. p. 138 (1862).
S. strictum Lindb. in Act. Soc. Sc. Fenn. 10, p. 263 (1872).
S. Hookeri C. Müll in Linnæa, 1874, p. 547.
S. leptocladum Besch. in Herb. Mus. Paris (1877).
S. acutifolium, var. *fallax* Warnst. in part, in Europ. Torfm. p. 42 (1881).
S. Warnstorfii Röll in part, in Syst. d. Torfm. Flora (1886).

This species is already known to inhabit Canada, New Hampshire, Massachusetts, New Jersey, and Miquelon Island (*Delamare*). How Cardot can decide to include this fine characteristic species as a subspecies of *S. acutifolium* (Ehrh.) I can not comprehend. Quite as properly might he also have considered S. fimbriatum as belonging to S. acutifolium. Both species are surely specifically distinct from S. acutifolium by the numerous pores in the stem cortex, by the occurrence of resorption in the stem leaves, as well as by the quite different pore structure of the branch leaves. S. Girgensohnii is very widely diffused in the northern parts of the northern hemisphere. I have a specimen from Japan (Herb. Mitten), which is monoicous. *S. Hookeri* C. Müll. from the Himalaya is only a very delicate squarrose-leaved form of this species, and in anatomical structure agrees perfectly with S. Girgensohnii.

The most important of the forms received from Mr. Faxon are the following:

Var. **coryphæum** Russ. in Warnst. Samml. Europ. Torfm. Serie I. no. 26 (1888).

Plants 15–50 cm. long, usually of a vivid green, light or dark, frequently dirty rust color to almost black in the lower parts. Coma usually beautifully stellate, more or less compact, either wide-spread umbrella shaped or flat-arched. Branches of the coma usually a little thickened to the end, sometimes very considerably so, more or less obtuse. Usually mesocladous, rarely macro- or brachycladous; homalo-, drepano- and catocladous, never ortho- nor anocladous; frequently eurycladous. In loose, deep tufts in very damp, mostly in quite wet situations, in pine or mixed forests. Stem leaves of medium size, generally brachyphyllous, length and breadth equal, or broader than long, rarely in some forms a little longer to a half longer than broad, usually from the broad base narrowed upward and at the apex slightly truncate and fringed. Median basilar (hyaline) cells usually much spread out [sehr stark gespreizt], never with pseudo-fibres, never hemiisophyllous. Pores of the cuticle large, numerous, bordered, or oftener not bordered. Comparatively abundant in fruit.—New Hampshire, White Mountains, 1,500 to 4,500 feet; Mass., Milton, 500 feet (*Faxon*).

Var. **stachyodes** Russ. in Warnst. Samml. Europ. Torfm. Ser. I. no. 50 (1888).

Plant 8–30 cm. long or more, slender to very robust,

usually in cushion-like tufts of small extent, prevalent in swamps of birch and alder intermixed with pines, on the borders of forests, into the depths of which it seldom penetrates, and preferring the comparatively dry situations. Of a spike-like habit, uniformly branched throughout the whole length, the coma not broader than the rest of the plant, comal branches usually penicellate-radiate. Homalo-, ano-, ortho-, and drepanocladous. Pale green, grayish green, often yellowish green to yellow-brownish, rarely vivid green. ♂ branches not clavate-thickened, rusty yellow. Stem leaves of medium size to small, rarely over medium size to almost large, mesophyllous, sometimes macrophyllous (length nearly twice the breadth); apex usually broad-truncate and fringed; for the most part with pseudo-fibres. As yet unknown in fruit.

Mt. Washington, N. H., 5,000 ft. (*Faxon*).

Var. **molle** Russ. in Warnst. Samml. Europ. Torfm. Series II, no. 115 (1890). Plants 5–15 cm. long and more, soft and delicate, bright- to rather dusky-green, sporting into yellowish and brownish tints to dusky brown-yellow, also bluish- or grass-green, below darker colored; meso- to macrocladous, usually drepanocladous, also homalo- and catocladous, eury- and dasycladous; forming rather extensive tufts in low wet grassy places in alder and birch swamps. Stem leaves of medium size to small, mesophyllous to narrow-mesophyllous; often with pseudo-fibres; hemiisophyllous forms are not rare; sometimes there are transitions to *stachyodes* and *leptostachys*.

New Hampshire, Profile Lake, Franconia, 2,000 ft. (*Faxon*).

B. *Stem leaves nowhere with completely resorbed cell-membranes and therefore usually dentate at the apex.*

a. Stem leaves slightly or not all narrowed upward, with rounded often cucullate apex, which is sometimes delicately fimbriate, linguiform, the broad border much widened downward.

a. Stem leaves large, broad-linguiform, usually wholly destitue of fibres and pores, only in the middle of the apex dentate or slightly fimbriate, hyaline cells in the upper part of the leaf rhombic with numerous membrane-plaits; not every one of the superficial cells of the stem cuticle with one pore; pores without rings; usually dioicous rarely monoicous, ♂ branches red.

3. *S. Russowii* Warnst. in Hedwigia, 1886, p. 225.

Syn.: *S. acutifolium*, var. *robustum* Russ. Beiträge, p. 39 (1865).

S. acutifolium, var. *roseum* Limpr. Milde, Bryol. Sil. p. 382 (1869).

S. acutifolium, var. *fallax* Warnst. in part, Europ. Torfm. p. 42 (1881); var. *polyphyllum* Warnst. Flora, 1882, p. 206; *varr. decipiens* et *flagelliforme* Grav. in litt. (1883); var. *strictiforme* Warnst. Flora, 1883, p. 373.

S. acutiforme Schlieph. et Warnst. var. *auriculatum* Warnst. Hedw. 1884, p. 117; var. *elegans* Schlieph. in litt. (1884).

S. Girgensohnii var. ε *roseum* Limpr. Kryptogamenfl. v. Deutschl. 4. Bd., p. 109 (1885); var. *majus*, Röll in litt. ad Schlieph. (1885).

S. Wilsoni Röll, var. *roseum* (Limpr.) Röll, Syst. d. Torfm. in Flora, 1886.

S. Warnstorfii Röll, var. *auriculatum* (Warnst.), var. *strictiforme* (Warnst.), var. *polyphyllum* (Warnst.), var. *fallax* (Warnst.) in part, f. *deflexa* Röll, f. *squarrosa* Röll, f. *teres* Röll, var. *strictum* Röll, var. *fimbriatum* (Warnst.) Flora, 1886; var. *pseudo-strictiforme* Röll in litt., var. *tenellum* Röll in litt.

S. robustum (Russ.) Röll, Flora, 1886, (all forms?).

General habit and color quite variable. Plants usually tall and strong, of the size of S. Girgensohnii, and also much resembling it; tufts loose and high or compact and low, whitish, yellowish green, pure green, brownish yellow, violet-, rose- and purple-red. Wood cylinder of stem, usually red, more rarely whitish. Stem cortex variably formed of 2–3 or 3–4 strata of cells, the superficial cells with isolated, irregularly distributed, small or large pores without rings; the inner cells with numerous small pores. Stem leaves large, broad linguiform, with somewhat undulate margins, only in the middle of the broad rounded apex dentate or somewhat fimbriate, the border much widened below. Hyaline cells in the upper part of the leaves large, broad, rhombic, mostly without cross-partitions, but with delicate membrane-plaits, all the hyaline cells with membrane thinnings, which rarely at the edges towards the apex change into isolated pores: mostly without fibres and pores, but rarely fibrose near the apex.

Fascicles 4 or 5 branched, distant or crowded, 2 or 3 stouter branches spreading, recurved, horizontal, curving upward or erect, longer or shorter, the pendent branches very long and closely appressed to the stem. Retort cells of the branch cortex with neck slightly bent outward, with always a large pore at the summit; often, also, with one in the middle. Branch leaves closely or loosely imbricated, mostly with a somewhat spreading, more rarely nearly squarrose, tip, very seldom almost secund, lanceolate, narrowly bordered, the upper margins involute, and at the transversely or roundly truncate apex dentate; with 2 or 3

plaits near the base, and the hyaline cells with plicate membranes. Pore-structure on both sides of the leaf similar to that of S. Girgensohnii, like that, also, having numerous large pores on the inner side of the apical half and near the margins. Chlorophyllose cells in cross-section isosceles-triangular to parallel-trapeziform, placed on the inner side of the leaf between the here slightly convex hyaline cells and free, enclosed on the outer side by the here much more convex hyaline cells, or free.

Dioicous, rarely monoicous. ♂ branches in the antheridium-bearing part clavate-thickened, always violet- or purple-red; perigonial leaves in form and in the structure of cells and pores not different from the rest of the branch leaves, mostly fibrillose to the base, more rarely with single cells near the base not fibrillose. Perichætial leaves as in S. Girgensohnii, sometimes red. Spores dimorphous; microspores in separate smaller capsules, globular, without polyhedron-faces (always?), smooth and yellow, 0.012–0.013 mm. diam.; macrospores 0.021–0.025 mm. sometimes 0.031–0.033 mm. diam., also smooth and yellow. Fruit rare.

Var. **pœcilum** Russ. *in litt.* (1887).

The forms belonging here are distinguished by a very dull violet-red beef-color. In some the violet is pure, handsome and bright, in others dirty and faded, in others the red is pure without admixture of blue. In the whole var. pœcilum there is added to the violet or violet-red a bright or pale gravish green, now clear, now clouded.

N. Hampshire, Crawford's, 1,900 ft., Franconia Notch, 2,000 ft.; Vermont, Westmore, 1,100 ft. (*Faxon*).

Var. **rhodochroum** Russ. *in litt.* (1887).

This series of forms is distinguished by a mixture of yellow or yellowish green with clear, delicate brick-red or almost rose-red; from this red, which is usually clearly impressed on the lower parts of the plant, the red of the male branches is plainly distinguishable, the latter always showing an admixture of blue with the red.

N. Hampshire, Crawford Bridle Path, 4,000 ft. (*Faxon*).

f. **dasy-anoclada** Warnst. Tufts extremely dense; spreading branches comparatively short, much crowded and ascending.

N. Hampshire, Crawford bridle-path, 4,000 ft. (*Faxon*).

Var. **Girgensohnioides** Russ. *in litt.* (1887).

This variety includes all the forms in which green predominates and which show, in greater or less degree, only a

very slight admixture of red. Those forms that show a greater proportion of red, but whose green perfectly agrees with that of Girgensohnioides, Russow has united in the sub-var. intermedium.

N. Hampshire, Mt. Washington, 4,000–5,000 ft., Mt. Lafayette, 4,000 ft., Franconia, 1,300 ft.; Vermont, Westmore (in fruit), 1,100 ft. (*Faxon*).

Var. **obscurum** Russ. *in litt.* (1887) as sub-var.

In the forms belonging here the tints are always smirched; the plants exhibit a clouded coloration which is produced by a mixture of dark dirty violet, brown and gray.

N. Hampshire, Mt. Washington, 5,000 ft., Mt. Willey, 2,500 ft. (*Faxon*).

β. Stem leaves smaller, linguiform, delicately fringed at the rounded apex, or abruptly contracted to a small, cucullate point, nearly always without fibrils and pores. Superficial cells of the stem cuticle without pores; wood cylinder always reddish brown, as is frequently the whole plant; dioicous; ♂ branches brownish.

4. *S. fuscum* (Schpr.) von Klinggraeff. Beschr. d. i. Preussen gef. Arten u. Varr. d. Gatt. Sphagnum (Schrft. d. Phys-öc. Ges. i. Königsberg 13, P. I. p. 4. n. 4. 1872).

Syn.: *S. acutifolium*, var. *fuscum* Schpr. Entw.-Gesch. d. Torfm. p. 57, t 13, fig. E (1858).

S. acutifolium, var. *fuscum* (Schpr.) Schlieph. et Warnst. Flora, 1884.

In extensive, dense or loose, often cushion-shaped patches. Color usually a peculiar grayish green intermixed with brown or reddish brown, more rarely whitish or green. Stem taller or shorter, according to the station, usually slender and delicate like S. tenellum and S. Warnstorfii.

Wood cylinder always reddish brown, with very thick-walled pith-cells.

Stem cortex variably formed of 3–4, rarely to 5, strata of thin-walled cells of medium width: superficial cells not perforated on the outside: inner cells with small pores.

Stem leaves usually small, linguiform; often at the rounded apex abruptly contracted to a small cucullate point, which is generally somewhat fimbriate; the broad border much widened downward. Hyaline cells nearly always without fibrils and pores; very rarely with rudimentary fibrils below the apex; 2 to 4 times divided by obliquely transverse walls, and with delicate longitudinal plaits in the membrane; basal cells saccately dilated downward.

Fascicles consisting of 3 or 4 branchlets, of which the stouter are sometimes long and much attenuated to the apex, sometimes shorter and abruptly pointed. Branches distant, or closer, or crowded, either falcately bent downward, horizontally spreading, curved upward, or strictly erect.

Branch leaves small, nearly lustreless when dry, densely or loosely imbricated, from an ovate base extending to a comparatively short, round-truncate, dentate, involute tip; bordered by 3 or 4 rows of narrow cells; a plait in the middle near the base. Hyaline cells on the inner side of the leaf, in the upper part, with numerous usually ringless pores, especially in the upper and lower cell angles; in the vicinity of the lateral margins of the leaf as well as directly over the base the pores are in the middle of the cell-wall, between the fibrils. On the whole outer side of the leaf the hyaline cells have numerous apertures which, at the apex of the cell, are small and strong-ringed, and below become gradually larger and weaker-ringed. In the lowest part they are very large and without rings, and are situated in the middle of the cell wall between the fibrils, while the rest are on the commissures. Near the edges the pores on the two sides of the leaf are partly opposite each other, so that at these points more or less complete perforations of the leaf occur.

Chlorophyllose cells in cross-section triangular to isosceles-trapeziform, placed between the hyaline cells on the inner side of the leaf and always free: on the outer side, sometimes enclosed, sometimes free, and here the hyaline cells are more convex.

Dioicous: ♂ branches very similar to the sterile, slightly or not at all thickened in the antheridium-bearing portion, here always yellowish brown, after flowering lengthening at the tips; perigonial leaves very small, sharply contrasted to the lower sterile leaves of the male branch, broad-oval, denticulate at the rounded apex. Pore structure like that of the other branch leaves, the lower half or two-thirds (rarely the whole leaf), without fibrils and pores. Fertile branches mostly short; perichætial leaves large, ovate, slightly emarginate at the rounded apex, broadly bordered, in the lower part with elongated, rectangular, pitted chlorophyllose cells, higher up with both kinds of cells of which the hyaline are once to four times divided by obliquely transverse walls, and at the apex with narrow, short chlorophyllose cells; always without fibrils and pores. Fruit rare; spores golden yellow, granulate or nearly smooth, 0.025–0.030 mm. diam.

Sphagnum fuscum is a genuine high-bog plant, and surely, in suitable localities in Canada and the northern United States, as in Europe, not rare.—Miquelon Island (*Delamare.*)

Var. **fuscescens** WARNST. Tufts brown throughout, almost entirely without admixture of green, the coma sometimes even reddish brown.

N. Hampshire, Mt. Washington, 5,000 ft. (*Faxon*).

f. **robusta** WARNST. Plants very stout and tall, with rather long, usually deflexed branches. Tufts dense or loose.

Vermont, Westmore, 1,100 ft. (*Faxon*).

f. **dasy-anoclada** WARNST. In extremely firm, compact, and often very deep patches. Stem with very thickly set, short, ascending branches.

New Hampshire, Mt. Lafayette, 4,000 ft. (*Faxon*).

Var. **fusco-viride** (RUSS.) as *forma*.—Color of the tufts a mixture of green and brown. Sometimes the green predominating; sometimes the brown, but always blended

N. Hampshire, Mt. Lafayette, 4,000 ft., Lisbon, 1,000 ft.; Mass., Mt. Graylock, 1,500 ft. (*Faxon*).

f. **robusta** WARNST. s. f. **drepanoclada** W.—Plants extremely stout and tall, loosely cespitose, in the upper part the green most prominent, the coma and the lower part browner. Branches long, rather distant, falcate-reflexed.

Mass., Dedham, 100 ft. (*Faxon*).

γ. Stem leaves now larger now smaller, usually cucullate at the apex through involution of the edges. Hyaline cells multipartite, nonfibrillose or in the upper part fibrillose. Branch-leaves frequently secund; wood cylinder of various colors but never brown; usually dioicous, rarely monoicous; male branches red.

5. *S. tenellum* (SCHPR.) VON KLINGGRAEFF Beschr. d. i. Preussen gef. Art. u. Varr. d. Gatt. Sphagnum (Schrft. d. Phys.-öc. Ges. i. Königsb. 13, P. I, p. 4, n. 5, 1872.

Syn.: *S. rubellum* Wils. Bryol. Brit. p. 19, tab. 60 (1855).

S. acutifolium γ *tenellum* Schpr. Entw.-Gesch. d. Torfm. p. 57. ta. b, 13. fig. γ (1858).

S. acutifolium, var. *rubellum* Russ. Beits. p. 41 (1865).

S. acutifolium, var. *tenue* Braithw. (1880).

S. acutiforme varr. *tenellum* et *rubellum* Schlieph. et Warnst. Flora, 1884.

S. Wilsoni Röll, in part, *S. acutifolium.*, var. *elegans*, f. *plumosa* Röll in Flora, 1886.

S. Schimperi, varr. *tenellum* et *gracile* Röll (1886).

Tufts soft, looser and taller or denser and shorter. Color quite variable, whitish, yellowish, green, rose-red or violet. Plants generally quite slender and soft, of the stature of S. Warnstorfii or S. fuscum.

Wood cylinder whitish or reddish; pith-cells thick-walled.

Stem leaves larger or smaller, linguiform, usually cucullate-incurved at the apex and sometimes at the sides, and afterward by spreading out flat becoming lacerate, dentate or delicately fimbriate: the broad border much widened downward; the margins slightly undulate. Hyaline cells with or without fibrils in the upper half of the leaf, two to four times (rarely six times) divided by obliquely transverse walls, and with delicate membrane-plaits.

Stem cortex formed of 3 or 4 layers of thin-walled cells of medium width, their outer walls not porose.

Fascicles distant or approximate consisting of 3 or 4 branches, of which the two stoutest diverge in various directions from the stem and are variable in length. Retort cells of the branch cortex with distinctly recurved neck and with an aperture at the apex. Branch leaves loosely or densely imbricated, frequently secund, ovate to ovate-lanceolate and small, dentate at the broad rounded apex, edges involute; margin bordered by 2 or 3 rows of narrow cells; with a longitudinal plait in the middle over the base, and the membranes of the hyaline cells with numerous plaits. The apical half of the inner surface of the leaf with numerous small pores, especially in the upper and lower cell-angles, and larger ones in the broader part of the leaf, especially near the margins; outer surface of leaf quite covered with pores which, in the apex, are strongly ringed and a little smaller than in the middle of the leaf, at the base very large and ringless, singly in middle of the cell-walls between the fibrils; near the edges situated, in part, opposite the inner pores and thereby producing complete perforations of the leaf.

Chlorophyllose cells in cross-section as in S. fuscum.

Dioicous, rarely monoicous; male branches in the antheridium-bearing portion always purple- or violet-red; perigonial leaves ovate, contracted to a small, rounded, denticulate, cucullate point; in the lower part without fibrils and pores. Perichætial leaves large, ovate, above abruptly contracted to a narrow truncate emarginate involute point; either formed in the lower part of pitted chlorophyllose cells only,

or, throughout the whole leaf except the apex, of both kinds of cells. Hyaline cells many times divided by transverse, oblique or longitudinal walls, and without fibrils and pores; the apex of the leaf formed entirely of short, narrow, thick-walled, pitted chlorophyllose cells. Margins broadly bordered. Spores dimorphous; microspores yellowish brown, polyhedral, 0.012–0.015 mm diam. in smaller urn-shaped capsules. Macrospores according to Limpricht ochre-colored, size ? Fruit very rare!

S. tenellum is, like S. fuscum, a plant of the elevated bogs, and should be found in suitable situations in Canada and in the northern parts of the United States as abundantly as in Europe.

Miquelon Island (*Delamare*).

Var. *rubellum* (WILS. *as species*).—Whole plant, especially in the upper part, pale-, rose- or purple-red to purple-violet, in the lower parts fainter but without admixture of green. Branch leaves frequently secund.

Mass., Boston and Brookline, 100 ft. (*Faxon*). Danvers, 100 ft. (*Sears*).

Var. **versicolor** WARNST.—Color a mixture of red (pale rose, violet red) and green; the former more especially in the coma, the latter in the other parts of the plant; the two colors very unequally distributed, now the red, now the green predominating; the lowest parts of the plants bleached out.

Mass., Boston, Brookline, Dedham, 100 feet (*Faxon*).

Var. **viride** WARNST.—Whole plants grayish or vivid-green, almost without a trace of red; the male branches violet-red.

Mass., Boston, Brookline, 100 feet (*Faxon*).

Var. **pallescens** WARNST. Plant above usually whitish, or faint yellowish green, in the middle sometimes light brownish or extremely faint reddish; male branches sordid violet.

N. Hampshire, Mt. Willey, 2,500 feet; Mass., Brookline, 100 feet (*Faxon*).

δ. Stem leaves small, linguiform, hyaline cells less divided, non-fibrillose or only near the apex faintly fibrillose. Branch leaves often distinctly five ranked, mostly curved erect-spreading, rarely in part slightly secund; the lower and middle leaves with very small, round, strongly-ringed pores on the outerside in the upper half. Wood cylinder variously colored, but never brown. Dioicous; ♂ branches red.

6. *S. Warnstorfii* Russ. in Sitzungsber. der Dorpater Naturforscher-Ges. Jahrg. 1887, p. 315.

Syn.: *S. acutifolium*, var. *gracile* Russ. Beitr. p. 44 (1865).
S. acutiforme, var. *tenellum* Schlieph. et Warnst., in part, Flora, 1884.
S. acutifolium, var. *Graefii* Schlieph. in litt. (1885).
S. Wilsoni Röll var. *tenellum*, f. *purpurea* Flora, 1886.

Tufts mostly loose, of greater or less extent, concolorous, light to dark green or yellow-whitish, reddish, violet- to dark purple-red, or often variegated by a mixture of green and red, or of a yellowish white and red. Plants usually delicate, slender and graceful, at the same time firmly erect, rarely weak: of various forms of growth: usually brachy-, eury-, homalocladous, seldom anocladous, never orthocladous, not rarely dasy-, drepano-, catocladous, seldom squarrose. Stem upright, slender, 3–15 cm. long.

Wood cylinder well developed, constructed of much thickened cells, usually reddish or violet to dark red, seldom colorless or greenish.

Stem cortex of 2 to 4 (very rarely 5) strata of cells; the inner cells relatively much thickened, and with numerous pits, the outer without pores, very seldom with a few here and there.

Stem leaves small to medium size, 0.40 to 1.50 mm. long, mostly linguiform, from the base very gradually narrowed and then rather abruptly contracted into a roundish-pointed dentate or entire apex; the narrow border much widened downward as in S. acutifolium. Hyaline cells in the upper half of the leaf rhombic to elongate-rhombic, mostly divided, sometimes into 3 or 4 daughter-cells, nonfibrillose, or not rarely with a few very delicate fibrils, in the former case with longitudinal plaits.

Fascicle formed of 3 to 5 branches, of which 2 or 3 are spreading. Leaves of the latter ovate in the basal half, thence extending with involution of the margins into a subulate 3 to 5 toothed truncate point; the leaves are often very regularly five-ranked, sometimes secund, always with their points diverging from each other; those of the pendent branches like those of the apical half of the spreading branches narrowly ovate to lanceolate, those at the base of the pendent branches broadly ovate.

The hyaline cells of the leaves of the basal half of the spreading branches are furnished on the outer surface with numerous pores, which in the upper half of the leaf are externally small, nearly round and very numerous and encir-

cled by a relatively broad, stout fibril-ring: the pores which occur in the lower half of the leaf, on the contrary, are large, oval and not numerous. In the leaves of the apical half of the spreading branches, and of the whole extent of the pendent branches, the pores gradually diminish in size from the base to the apex of the leaves, and the small pores of the apex are much larger than the corresponding ones in the leaves first mentioned. Pores on the innerside of all the leaves more numerous in the lower part of the leaf and near the margin, large, mostly destitute of rings, and in part opposite to the outside pores, whereby complete perforations of the leaf often occur.

Chlorophyllose cells placed on the inner side of the leaves, and in transverse section trapezoidal, more rarely triangular, whence the hyaline cells, which are more convex on the outer surface, are more or less separated from each other.

Dioicous; ♂ branches clavate, long subulate-pointed, color light to dark red. Perigonial leaves broader and shorter than the leaves of the sterile branches. The hyaline cells in the lower half nonfibrillose and nonporose, very seldom furnished with distant, very slender, incomplete fibrils; in the upper half with very small broad-ringed pores. Female flowers as yet unknown. Perichætial leaves large, ovate-lanceolate, in the lower part constructed of chlorophyllose cells only, in the upper part of both kinds of cells, of which the hyaline are always nonfibrillose and often 1, 2 or 3 times divided. Capsule comparatively large, dark reddish brown. Spores dark yellow, rough with minute warts. Fruit extremely rare.

This small, delicate and extremely beautiful peat-moss is easily and certainly distinguished from the nearest related forms of the *Acutifolium* group, especially from *S. tenellum* v. Klinggr., chiefly by the remarkably small broad-ringed pores on the outside upper half of the lower and middle leaves of the spreading branches. The pores are here smaller than in any other European species, and are the more striking to the eye because they approach closely to the large pores of the lower half of the leaf almost without gradation of size. In S. Wulfianum also the pores are very small in the apical half of the leaf, sometimes not larger than in the present species, but they increase in size gradually and but slightly towards the base of the leaf and in its median line; in this case the very large pores of the two flanks of the leaf contrast strikingly with the small ones of its median line.

S. Warnstorfii prefers damp or wet birch swamps, and the margins of elevated bogs when adjacent to birch-covered wet meadows; or it grows in springy swamps, here preferably in the society of *Paludella squarrosa* Ehrh. It is often found associated with S. teres, whilst it seems to shun the company of S. tenellum and the other species of the *Acutifolium* group.

This plant must surely be as widely diffused in Canada and the northern United States as it is in Europe, but hitherto, at all events, it has been overlooked or not specifically distinguished.

Var. **purpurascens** Russ. in litt. The upper part of the plants of a beautiful rose, purple or violet-red, below usually paler; with this color no green is intermixed.

N. Nampshire, Franconia, 1,000 to 1,500 ft., Lisbon, 800 ft.; Vermont, W. Burke, 1,000 ft.; Mass., N. Adams, 1,500 ft. (*Faxon*): Danvers, 100 ft. (*Sears*).

Var. **versicolor** Russ. in litt. Color of tufts a mixture of red and green; coma usually pale, rose, purple or violet-red, the middle part of the plant green or greenish, the lower part bleached out.

N. Hampshire, Franconia, 2,000 ft.; Vermont, Westmore, 1,000 ft.; Mass., Mt. Graylock, 1,500 ft., Brookline, 100 ft. (*Faxon*).

Var. **viride**, Russ. in litt. Color throughout green or greenish, with here and there a delicate flush of pale red; lower part of stem faded out.

Vermont, Willoughby Lake, 1,100 ft.; Mass., Mt. Graylock, 1,500 ft., Dedham, 75 ft. (*Faxon*).

Neuruppin, Germany, Feb. 6, 1890.

Notes on the flora of the Lake Superior region. I.

I. The Northern Peninsula of Michigan.[1]

E. J. HILL.

During the summer of 1889 a few weeks were spent in collecting and studying the flora of the Lake Superior region, with a brief stay on the way back at St. Croix Falls and Chesago Lake in eastern Minnesota. About two hundred species of plants were secured and have been critically exam-

[1] Read before the State Microscopical Society of Illinois, April 25, 1890.

ined, either new to me or interesting for study and preservation. The collecting season lasted from July 10 to September 6. The localities visited were the Marquette iron region, extending from the west end of Lake Michigamme to the city of Marquette, a port of Keweenaw Peninsula in the copper region of Portage Lake and vicinity: and a portion of the iron region of Vermilion Lake, at Tower, Minn., with the addition already mentioned in eastern Minnesota. Strictly speaking the district about Vermilion Lake is not a part of the Lake Superior country, as it belongs to that which drains northward into Hudson's Bay. But in the language of the miners and lumbermen, who carry on its two principal industries, it is included, since its commercial outlet is Lake Superior. A large part of the Marquette iron district is also exterior to the basin of Lake Superior, belonging to that of Lake Michigan, but is included for a like reason.

One of the principal objects in visiting these localities was the comparative study of the flora of Lake Superior and that of Lake Michigan. As far as the latter lake is concerned, my work in past years has been distributed in such a way as to be made continuous with its length with immaterial exceptions. Its north and south direction furnishes an opportunity to study plants varying from those of middle temperate to the sub-alpine.

In the summer of 1883 several weeks were employed in a similar way in the Menominee iron region, and the most important results were published soon after in the BOTANICAL GAZETTE. It is only a little farther to the Marquette district. We are there at the head waters of the Escanaba and the Michigamme, the main branch of the Menominee, which chiefly drain it, and pass southward into Lake Michigan. Dead river and Carp river, that go eastward into Lake Superior, are but minor streams. All the collecting in the Marquette district, except immediately around the city of Marquette, was about the head waters of these streams. Here is the highest part of the basin of Lake Michigan, Michigamme Lake being more than a thousand feet above its level. It is only a few miles beyond to the watershed of Lake Superior, formed by the low ridge of the Huron Mountains, about 1,800 feet above sea-level, and the highest land in Michigan. Short streams come down their southern slope to the Escanaba and Lake Michigamme, the Bi-ji-ki being the largest one. The Escanaba rises close by, the eastern affluent of the lake being a mere brook barely a mile in length. Hard

ridges of granite and diorite and the schists of the Huronian and Laurentian formations turn the Escanaba eastward at first, while the Michigamme cuts across them to the south, forming a series of rapids and waterfalls. Swamps, small lakes and ponds abound among the hills, and the aquatic and semi-aquatic vegetation, as well as that characteristic of the forest and cliffs, is abundant and varied.

Lake Michigamme, near which a fortnight of the time was spent, is one of the larger lakes of the Northern Peninsula, being about six miles long and from one to three wide, with a large arm stretching southward. It is quite irregular in form and has several beautiful islands, mostly masses of dome-shaped rock covered with trees, which make it one of the most picturesque of these lakes. Great ledges of rock frequently abut on its northern shore, the southern being a graded slope clothed with timber.

Much of this region has been overrun by fire, as the bare and blackened trunks in the fields and woods witness. Much of what the fire spared has fallen before the axe of the lumberman and the charcoal burner, for the demands of the iron industry have made large inroads on the hardwood timber. Abandoned furnaces and coal-pits show that this part of the industry has gone elsewhere, and there are but few smelting works in operation in the Marquette district. Coal has supplanted wood, and commercially it is found more economical to take the ore to the coal than to bring the coal to the ore. But it has often left a scene of desolation which nature is trying to hide, and will eventually succeed in doing, if the fires are kept away, by reforesting the desolated tracts. Some of the better land along the streams and smoother uplands is taken for agriculture and will be increasingly appropriated, and one comes upon farms now and then in a fair state of cultivation. But much, from its very ruggedness, must always remain for woodland, or should be left for this purpose on account of the greater profit to be derived from it. And here the problem of wise forestry regulations comes in for solution, one of the most important economical questions of the immediate future. It can not be taken in hand too soon for the good of the states interested, and the welfare of those who shall come after us. It will take a century or more to replace but partially the woodlands, that by proper management might still have been a paying investment. Here the greed of man has overreached itself, and the desire of large and rapid gains has wrought untold mischief. Happily

there can be reparation, but the process will prove a long and costly one, enforcing the lesson that there is no gain in the end in tampering with the wise provision of nature.

I shall mention in this article those plants only that seem most important botanically, either by variations, habitat, or other conditions. One of the first discovered, as well as most interesting on account of its locality, was found near the Champion mine. Having examined this extensive mine the morning after reaching the place, and seeing a piece of swampy land just south of it, into which the waste rock from the mine is thrown and its water pumped, I went down to find what might be detected there. Growing in patches on the wet stones and soil was a moss-like plant, an inch or two high, which, on inspection, was seen to belong to the Pink family, but just what was not evident at sight. When identified it proved to be a specimen of *Sagina procumbens* L., in this seemingly out-of-the-way place. It grew in plenty in this locality, but was met with nowhere else about the upper lakes. Its main interest arises from the fact that, as represented in the flora of North America, it has heretofore been found on the Atlantic border, being essentially a coast plant, ranging from Greenland to Pennsylvania. Hence it adds another to the list of plants occurring along the Atlantic borders and in the basin of the Great Lakes without intermediate stations. It is a plant widely diffused in the northern parts of the Old World, being common to Europe and Asia, and, according to Sprengel, found in pastures in northern Africa. In the eastern continents it is a dry-land or pasture plant. Torrey, in his "Flora of the Northern and Middle Sections of the United States,"[2] has this remark upon it: "The habitat of this plant differs from the European species, which occurs in dry soil. In every other respect they agree precisely." Gærtner[3] figures a stem of it in his work on the fruits and seeds of plants, and a sprig of that found at Champion might have been employed for the drawing, as it agrees precisely.

Convolvulus spithamæus, as found in this region, takes a form somewhat different from that further south. It was noticed by its prominent white flowers along the railroad from Green Bay northward, and recognized as of the morning glory kind, but not identified from the car windows with the plants seen in fields beside the Kankakee and Calumet rivers. The latter generally have decumbent stems one or

[2] p. 195.

[3] De Fructibus et Seminibus Plantarum, 1791, Vol. II, tab. 129.

two feet long, but the northern plant grew nearly or quite erect, with a stem but two to six inches high, and the flower so near the ground as seemingly to rest upon it. The effect was very pleasing when they were massed, as they sometimes were, especially on dry knolls in the newly cleared fields, the ground being spangled with the white blossoms so much more prominent than the stems.

The Virginian Lungwort further south seems here to be replaced by *Mertensia paniculata* Don., near enough like it to be at once recognized as a Mertensia, but with a look a little unfamiliar. This is not a smooth plant, and is more slender than M. Virginica, with ribbed leaves of a different pattern, but it has the same pale-green, sleek appearance. It grows in the margin of rocky woods and did not seem abundant.

Hieracium scabrum frequently had a character which somewhat belied its specific name, the leaves being quite smooth and the stem mainly so except the dark glandular bristles near the top and upon the flowers. It was of a stout form, a foot or two high, growing in the dry open grounds and open woods. I found it first at Humboldt, and afterward at Negaunee and Marquette, always in the same dry, open localities.

Krigia amplexicaulis Nutt. (*Cynthia Virginica* Don.) was common in damp ground, sometimes taking to the hummocks in the bogs, and it occasionally had lower leaves lyrately pinnatifid. It affects much dryer situations in the prairies and sands about Chicago, where it may sometimes be found in company with K. Virginica.

But one more member of the Compositæ needs be mentioned, an anomalous form of that "most polymorphous species," Senecio aureus. It was a rayless form of an otherwise nearly typical plant. In some respects it resembled the var. *borealis* Torr. & Gray, of British America and some parts of the Rocky and Sierra Nevada Mountains, but it is a taller plant and with the stem leaves divided as in the common form. The radical leaves are thick, almost succulent, purple beneath, spatulate and serrate with long petioles. It is a prominent plant in open grassy spots of peat bogs, from one to two and a half feet high, and was mainly found along the railroads, being traced from the north shore of Lake Michigamme to the neighborhood of Humboldt, and was not seen elsewhere. The heads are numerous, corymbose, or cymose-umbellate, of a saffron or orange color, and all that

were examined, which was done in many plants, were without rays. Pursh (Flora, p. 529), under S. elongatus, describes the form very well as far as characters are given. He says it resembles S. Balsamitæ, "but is destitute of a ray." As the latter, being a variety of S. aureus, is common in the prairies about Chicago, the resemblance of the northern plant to it had been remarked, though this is rather taller than the var. Balsamitæ, and destitute of its prominent rays. The plant has also the thick leaves of var. *obovatus* Torr. & Gray. Pursh's S. foliosus is placed in the "Synoptical Flora" under var. borealis, with the range given above. Pursh designates as the habitat of his plant "rocks near the banks of rivers," and the special locality he mentions is "Easton, Penn." Evidently this northern plant, though referable to the type, partakes of the specific characters of two or three of the varieties.

Among the plants growing in bogs may be mentioned Geum rivale, tall and striking by reason of its large purple flowers and heads. Drosera rotundifolia was found near Marquette with branching scapes, they being almost always simple. And in the same locality three sports among Orchids were seen, a family that seems somewhat inclined to teratological vagaries. One was the common Calopogon pulchellus with a second linear leaf nearly opposite the usual single leaf it bears, but smaller; another was Habenaria lacera with a flower having three spurs and two lips, one of the lips again dividing as if to maintain the tri-formity. Two columns were also present. Pogonia ophioglossoides with a radical leaf on a long petiole was the third case. It is the second time I have seen this peculiarity, having found a similar form at Pine, Ind.

Another Orchid, Corallorhiza innata, remarkable for the size of the plants, being from 12 to 14 inches high, grew in the shade of hemlocks by the borders of Teal Lake, Negaunee. It is generally a slender plant but 4 to 8 inches high.

Of shrubs may be noticed a species of honeysuckle, mainly northern in range, *Lonicera hirsuta* Eaton, that grows on rocks and in moist sandy ground. It usually forms a climbing bush, sometimes to the height of 20 or 30 feet, or more, but specimens found on the "Granite Range," north of Champion, were of a trailing habit for the lower part of the stem, the upper part rising from 15 to 24 inches. The species often shows little more tendency to climb than L. glauca, the low shrubs being nearly upright, or partly sup-

ported by neighboring bushes. I have always found it rather small in the region of the upper lakes. The plants were also peculiar in their flowers, yellow changing or fading to red. This also links them to L. glauca, whose flowers are greenish-yellow to purple, commonly purple in this vicinity. Our common American Woodbine, L. grata, also has flowers changeable in color, but it is the reverse, fading from purplish to yellow. *Rubus Nutkanus* Mocino, or, if we are able to take the name of Nuttall, *R. parviflorus*, grows everywhere on the rocky hills that have been denuded of trees, and in clearings, often thickly covering the ground like other species of bramble. It is usually smaller than its congener, R. odoratus, common at the east and also found in the Upper Peninsula, and bears a fruit fragile but palatable. Birds are apparently very fond of it.

The hazelnut of the Northern Peninsula, or at least of the northern part of it, is Corylus rostrata, well marked by the long beak of the involucre. It was very abundant in some parts of the Keweenaw Peninsula. When at Sault Ste. Marie, in 1881, it was found to be the prevailing species there on the Canadian side.

Some of the aquatic plants deserve notice. Hippuris vulgaris is not so rare a plant as it was formerly thought to be, but is frequently met with in the region of the upper lakes. It is rather local, but quite widely disseminated. It proves itself a plant readily conforming to a change of condition in its usual habitats, becoming semi-aquatic or even terrestrial if the water dries away or recedes from the shore, doing well except being dwarfed in size. I saw a good example of this in a mill-pond at Otis, Ind., last autumn. The water was low and had withdrawn to a distance from its usual limit. A wide reach of muddy flats was left, green with Hippuris. The stems were too slender to stand upright, evidently having grown at a higher stage of water, and leaned over to one side, the extremity, well covered with flowers and fruit, moving upward into an erect position. At Tower, Minn., it was found in a terrestrial form, growing with *Polygonum Muhlenbergii* Watson, and *Ranunculus multifidus* var. *terrestris*. This terrestrial habit had been noticed before in plants in the Menominee iron region. Though regarded as a plant with a simple stem, it is not always so. Some tall plants with stems bearing two or three branches were taken from the borders of Bi-ji-ki river, near Michigamme Lake.

It is not always easy to determine at sight which of our

two white water-lilies one may have in hand when he picks a blossom from its stem, nor convenient to "go to the root of the matter to see," one of the chief characteristics being so radical, but generally those seen in the Northern Peninsula were designated *Nymphæa reniformis* (*N. tuberosa* Paine), judged by the flowers and other marks when compared with those common in all our waters. In fact, I have never found an undoubted example of N. odorata about Chicago, although it is said to grow here. When the parts underground are examined they prove to be tuber-bearing. The shape of the leaf is unreliable. And so it was in northern Michigan. The plants grew in great abundance in Goose Lake, near Negaunee, the flowers were pretty large, with but little odor, and the roots bore the characteristic tubers. When botanizing at Petoskey, in 1878, some plants of N. odorata were collected in a shallow lake, having rather small very sweet-scented flowers, like those common in New England. It doubtless occurs throughout these northern regions, as it is said to be abundant in northern Minnesota and British America, but the Petoskey specimen as yet remains my only undoubted case.

Species of Potamogeton were particularly sought after, both for studying their variations and geographical distribution. On the whole they show considerable variation, and the published descriptions need some changes or enlargements to facilitate easy determination by those not specially versed in the group. P. rufescens is naturally looked for in the north, where the waters or climate seem more congenial to its growth, and was seen in several places. In the summer of 1888, while passing a month in studying the flora of the lower Saguenay, it was seen to be the most common species in the clear, cold waters of the trout lakes and streams about Chicoutimi and Tadousac. P. amplifolius and P. Pennsylvanicus are still more common in the Lake Superior region, the former particularly of wide distribution and abundant in places. P. amplifolius, with branching stems, is not uncommon throughout the lake region, and this distinction between it and P. Illinoensis will not hold. Then we find it has pointed, bi-carinate stipules.

P. Robbinsii was met with twice, first in a pond at Republic, and afterward at the outlet of Goose Lake, south of Negaunee. Later in the season it was again seen in great quantities in Chesago Lake, Minn. Hence, I conclude that it is more widely spread in our northern regions than has

hitherto been suspected. It is not mentioned in the floras of these sections as far as they are at hand. The farthest west and north where I had found it before was Cedar Lake, in northern Indiana. As it is known to occur on the north shore of Lake Superior and in the Rocky Mountains and on the Pacific slope, it is probable that the intervening region may be occupied by it, and that it will ultimately be found to extend across the continent. It is easily overlooked, being almost always completely submerged, and if the water is not clear may escape detection. I have sometimes been made aware of its presence in the water only by dredging. Wherever seen, it proves one of the best marked and least variable species of the genus.

P. heterophyllus Schreb., under two extreme forms of type, was collected. It is extremely variable, and, if the characters were based on foliage alone, one might think he had found two different species. Two of the gatherings were of special interest on account of the variability of the floating leaves, both from the Keweenaw Peninsula. One, from pools and sloughs near the northern end of Portage canal, has large floating leaves, some of them 1¼ inch wide by 1½ inch long, and 18-nerved. The leaves of the species usually end in a short mucro, or they may taper to an abrupt point ending in a mucro, but on these specimens some leaves were pointless, complete ellipses, very symmetrical in outline, the base and apex of the same shape. I have found plants with leaves of similar shape, as large as these or even larger, but they all possessed the characteristic mucro. Some of these plants had become partly terrestrial by the water drying up, which is frequently the case with this species. It grows very well in wet sand or mud, with prostrate stems three to six inches long, the leaves being crowded into a kind of tuft at the end. It is more tenacious of life than most Potamogetons, which commonly perish if the stems are not immersed. The other form, found in pools and ditches near Calumet, approached the var. graminifolius, but with shorter immersed leaves and larger floating ones. These were long, narrow and acute, or more often acuminate, lanceolate in outline, the largest nearly three inches long by ⅝ inches wide, and the smaller in proportion. The petioles were also very long and slender. All tapered in such a way that the mucro had disappeared. I have seen the same shape of leaf in plants near Chicago along with the ordinary kind, but not characterizing the en-

tire plant as in this case. The submersed leaves were also somewhat long and tapering, as in var. graminifolius, but the stems had the habit of var. myriophyllus, rooting extensively and sending up frequent branches. The stipules, too, partook of the tapering character, being barely obtuse, or sometimes acute. But the fruit in both forms is identical and typical.

P. heterophyllus, as may be seen in the above case, furnishes a good illustration of one mode of working with a polymorphous species, and shows how easy it is to be led to make varietal distinctions which do not definitely hold, but frequently add to the confusion in which the student is placed. Having collected or seen this plant in many stations and numerous examples both in the west and east, I have generally found that a search among a number of plants of the same locality, and sometimes an examination of the leaves on the same stem, will show transition forms—those shapes characteristic of one extreme being sparsely represented on plants whose prevalent shapes are of the other extreme. There is a tendency, however wide the variation, to adhere to a common type, which may be eliminated by patient study. I have often found many of the varietal designations of botanists more bewildering than helpful, for connecting links are quite sure to appear which are just as hard to assign among the varieties as to the type. It would seem the better way to enlarge the specific description so as cover all but very pronounced and constant varieties, and do away with some of the hair-splitting that is not a gain to science. In fact, we find in variable plants something to remind us of the theory of the great German artist of the renaissance, Albrecht Dürer, which he advanced in regard to the measurement of the human body. It was in substance that as every individual varies from the typical man in a way peculiar to himself, these variations will, in an infinite number of measurements counteract and destroy each other, and the type will be found. It might be well for the makers of species to bear this in mind and consider as one those whose characters overlap too far and which can not be differentiated with a fair degree of definiteness.

Englewood, Ill.

BRIEFER ARTICLES.

Some western plants.—*Astragalus Tweedyi*, n. sp.—Perennial, one to two feet high, somewhat branching above, whole plant finely pubescent with white appressed hairs, the cylindrical calyx more pubescent, the short teeth densely so: leaflets 6–12 lines long, 6–10 pairs; the short stipules free: pedicels much longer than the leaves; the white or pale yellow flowers twice as long as the calyx, on short pedicels which have persistent linear-acuminate bracts of about the same length: the turgid pods somewhat curved upwards or erect, strictly one-celled, acute at each end at the lower tapering into the half inch long somewhat inverted stipe.

Allied to *A. collinus* Dougl., but well distinguished by the erect, more turgid pods, the narrower less numerous leaflets, etc. It was collected by Mr. Howell "in prairies, Eastern Oregon" and distributed by him as *A. collinus* Dougl.; and by Mr. Tweedy (no. 613), and Mr. Brandegee (no. 731), on "hills along the Columbia river, Yakima county, Washington territory."

Prof. Greene, in the "Bulletin of the California Academy of Sciences no. 3, at page 157," takes up Dr. Gray's *A. collinus* var. *Californicus* and makes it his species *A. Californicus* evidently, I think, under a misapprehension of the original A. collinus, which he describes as having erect pods; whereas Hooker's original description, which is exactly copied in Torrey & Gray's Flora (1 vol. p. 347), says they are "deflexed." I presume Prof. Greene was deceived by Howell's specimens and name. The Californian plant should, therefore, remain as *A. collinus* Dougl., var. *Californicus* Gray.

Erigeron.—No. 77 in part, in the collection of the Northern Transcontinental Survey. Little Belt Mountains, Montana, F. L. Scribner, Aug. 12, 1883. Whole plant pubescent with short white appressed hairs (which become somewhat more copious and spreading on the involucre), small and low (two inches high), from a deep perennial root which bears at its crown the vestiges of the leaves of former years: stems several, simple, bearing single small heads: radical leaves as long as the stems, narrow linear; those of the stems few and small: involucre a quarter of an inch wide and high, of linear acute scales of equal length: rays 15–25, small, white: achenia compressed, not nerved, somewhat silky pubescent; pappus double, not copious, the outer short, the inner two-thirds the length of the disk flowers, more plumose than in allied species.

Nearly allied to *E. pumilus* Nutt., but with the pubescence of *E. canus* Gray, and much smaller in every way than either. The material is scanty, but I hope that more may soon be collected. Should it stand as a species, as I anticipate may be the case, I should propose the name of *E. Scribneri* in honor of its first collector.—Wm. M. Canby, *Wilmington, Delaware.*

New mosses of North America. III–IV. Renauld and Cardot [Botanical Gazette XV, pages 39–45 and 57–62].—In these numbers the authors describe 13 new species and 14 new varieties. We are not qualified to criticise all these additions, not having been favored with specimens: but of DICRANELLA LANGLOISII we have a piece of the type from M. Cardot and abundant specimens from A. B. Langlois and we find a distinct inverted annulus.

DIDYMODON HENDERSONI was evidently described from old imperfect specimens, like ours collected March 14, 1885, by L. F. Henderson. These show the young pedicels with a few immature capsules and the old fruit of the previous season. In the former the pedicels are "paler," but in the old ones they are quite as dark as in D. luridus. The average size of the capsules is in excess of ours, which measure one to two mm. in length. The drawings seem to have been made from the young green leaves at the tips of the fresh branches, whereas the older brown ones on the stems of the previous year do not show such triangular, blunt apexes and have a prominent dark brown percurrent costa not ceasing below the apex as figured.

COSCINODON RENAULDI. M. Cardot fails to state that I sent him at his own request from the Austin herbarium Mrs. Roy's Colorado specimens telling him that they are labeled Grimmia Raui in Austin's own hand. I have since seen specimens from E. A. Rau which agree with those in Austin's collection; they are labeled "No. 28, Colorado specimens Grimmia Raui." They are the ones drawn by E. A Rau at the time the description was published. The original drawings, in our herbarium, are marked "leaves throughout chlorophyllose, except the excurrent costa or tip, peristome examined rather young." The teeth are drawn almost entire or slightly perforate. What Austin probably meant when he said "*costa valida sub apice finiente*" [Bull. Torr. Bot. Club, vi. 46] was, that the green portion of the costa and the leaf cease before reaching the apex, i. e., the hyaline point is decurrent and above the green, careful focusing is required to see the costa, whereas, below, it is very heavy. The types show all stages of perforation of the teeth, from those nearly entire to others which are divided into three slender, entirely separate portions.

I am quite in sympathy with the editorial in the March number, and think "the righteous, conservative systematist" will have to do some "boiling down" and "weeding out" in the future. We doubt not that American bryology will profit by rigid comparison with European species, but our collectors are at fault in contributing insufficient material, too often sterile and imperfect; and the European bryologists in being too independent of American collections and students.—ELIZABETH G. BRITTON, *Columbia College Herbarium, New York.*

EDITORIAL.

THE GAZETTE desires to call the attention of its readers to the coming meeting of the American Association in Indianapolis. Every effort is being made to have a noteworthy botanical meeting, and as botanists claim to be the best organized scientific brotherhood in the country they should show their strength and spirit. A great railroad center, ample accommodations, and a hospitable people, speak well for comfort of travel and entertainment. In order to give more point and pith to botanical discussion, one of the topics was selected at the Toronto meeting and certain botanists were appointed to prepare papers upon special parts of it. "The geographical distribution of North American plants" is a subject of great interest to American botanists, and the botanists selected to present various phases of it are Watson, Macoun, Sargent, Britton, Underwood, Halsted and Coulter, all of whom have accepted their appointments. Many other botanical papers will be read before the biological section; while the meetings of the Botanical Club, always large in numbers and interest, will furnish ample opportunity for the more informal discussion of all sorts of botanical matters. The fact that a botanist, Dr. Goodale, is the president of the Association and the first botanist to serve in that capacity since Dr. Gray's presidency at the previous Indianapolis meeting, should still further stimulate a large attendance of botanists. Taken altogether, the programme is an unusually attractive one to botanists and back of it all, and more than papers, is the personal association of botanists, which makes them better friends and more generous rivals, and which enables them, amidst all the conflict of opinion, to recognize a common purpose and a downright goodfellowship. The GAZETTE, naturally, has something of a personal interest in this meeting, and in a certain sense is among the hosts that will warmly welcome as guests the whole botanical fraternity.

CURRENT LITERATURE.

Bacteriological technology.[1]

The title of this little book sufficiently describes its character. It is a hand-book of bacteriological methods for physicians. It contains, therefore, the more important methods only, and then in many cases modified to meet the conditions of work in a private laboratory where economy of space and of money is a necessity. The methods of preparing culture media and of staining are those in ordinary use and demand no special criticism. They are well and clearly stated, and the book gives the important operations of bacteriology in a concise and usable form. We have tested the book in a bacteriological laboratory during the past

[1] SALOMONSEN, C. J.—Bacteriological Technology for Physicians: translated from the second revised Danish edition by William Trelease. Wood's Medical and Surgical Monographs, vol. iv, pp. 435—597, figg. 72, 8vo. New York: Wm. Wood & Co., 1889, $1.

winter and have found it accurate and sufficiently full in its statements to enable the student to perform the operations described.

The translation is well done and many of the most important criticisms of methods and practical hints have been added by the translator.

The defects of the work are those of all similar hand-books on the subject. The chief fault is the lack of sharp criticism of the methods and apparatus described, so that the student at a distance from larger institutions can readily tell what he wants for a given case. This is especially noticeable in the chapters on anaerobic cultures and moist chambers.

The improvised apparatus described is usually good and serviceable. One must doubt, however, whether a really practical hot-air sterilizer will be made from a cracker box, as even slight carelessness, almost unavoidable in beginners' work, would melt the solder out of much of the box. A sheet-iron box can be constructed cheaply enough to meet all practical considerations of economy.

The publishers have not done their duty by this manual. It is published as part of a series and is bound up with papers on the knee-joint and the eye. It has no index, table of contents, or running headings, and the book must be largely committed to memory before easy use can be made of it. This is asking too much. If a good index could be provided, and the book bound in cloth separately, it would find a place as a handy and practically useful laboratory manual. E. A. BIRGE.

The plants of New Jersey.

New Jersey has always been considered our most interesting eastern botanical field, a sort of Mecca for collectors, an unrivaled region for rare plants. The consequence is that it has cultivated an active race of botanists; and lying so near such centers of botanical activity as New York City and Philadelphia, it must have been more carefully explored than any other state. As a result, we have before us the very handsome and complete catalogue of plants[2] prepared by Dr. N. L. Britton, with the assistance of numerous botanists. The catalogue includes all groups of plants, and giving stations and collectors with considerable detail, it forms a bulky volume of more than 640 pages. The tabulation made at the end of the volume is interesting, and is as follows: Phanerogams 1919 (1348 dicotyledons, 558 monocotyledons, and 13 gymnosperms): Pteridophytes 76 (47 of which are Filicineæ): Bryophytes 461 (312 of which are Musci): Thallophytes 3021 (329 lichens, 987 algæ, and 1705 fungi): Protophytes 164 (111 of which are Cyanophyceæ). The total number of species and varieties enumerated is 5641. The catalogue is a credit to the state and to the botanists who have collected there: and it is to be hoped that other but less favorably situated states will at some time be able to make as complete a presentation of their plants.

[2] N. L. BRITTON.—Catalogue of plants found in New Jersey. [From the final report of the State Geologist, Vol. II.] pp. 642. Trenton: 1889.

OPEN LETTERS.

An appeal to botanists.

For many years I have published a general analytical herbarium of useful plants. This publication, chiefly for teaching purposes, furnishes indispensable material for colleges, universities, etc., and was very favorably spoken of by: Zeitschrift der Deutschen Botanischen Gesellschaft (Nov. 27, 1885); La Belgique Horticole (p. 247, 1885); The Journal of Botany (March, 1886); Botanische Zeitung (p. 158, 1887); Oesterr.-Botanische Zeitschrift (p. 299, 1887); Revue Horticole (p. 179, 1888); American Garden (p. 207, 1888); THE BOTANICAL GAZETTE (December, 1888). In addition, very favorable opinions have been received from Prof. Engler (Director of Bot. Garden at Berlin), the Linnean Society (London), Prof. Willkomm (Smichow), Prof. Henriques (Coimbra, Portugal), Prof. Oudemans (Amsterdam), Prof. Rauwenhoff (Utrecht), Prof. Suringar (Leyden), Prof. Tschirch (Berlin), Prof. Carruthers (British Museum), etc The plants of my publication I mostly cultivate myself, with the exception of the tropical trees and palms, which I get from my Indian correspondents. Now, however, my garden has become much too small, and I am obliged to look out for a larger one or give up my publication. I, therefore, want assistance from every one interested in botany and teaching. The proposed garden I will lay out in Holland in a district best suited to the purpose, and with the assistance of professors of botany. It must contain all species of hardy, useful plants, and some hot-houses for small tropical ones. The garden should be as extensive as possible and suited to the purpose. The space to be occupied by it depends upon the contributions I get, and for this purpose I want $15,000. Daily I receive letters promising assistance. The usefulness of my publication is already proved by the favorable opinions of so many botanical authorities, and because there has never before been published a herbarium of this kind (with dissections). I have got many subscribers among botanists in Europe and America, from universities, colleges, high schools, etc. It would be an assistance to botanical knowledge to contribute to the botanical garden I propose to lay out, and I hope my appeal will not be in vain. The Linnean Society, at London, will give the necessary information about my specimens, and Prof. Coulter, editor of this journal, has consented to receive American contributions.

Middleburg, Holland M. BUYSMAN.

Study of buds.

I am always very grateful for hints, from any source, which may serve the teacher in making his lessons in botany clearer, more interesting and more philosophical. I take it for granted that other teachers are of the same mind, and I therefore venture to send you such a hint, or may I call it *trick*, which has served me well in lessons upon buds. This part of botany is taught early in winter, but twigs of hickory, lilac, tulip ree, horsechestnut, beech, etc., may always be had for the trouble of at short walk to get them. I aim to make the pupils get such twigs for themselves. From these specimens they learn all they can and in as orderly a manner as possible, by observation, comparison and drawing.

The position of the buds on the stems, the relative sizes, the scales, the scale rings of previous years, the leaf scars, etc., are made out by the pupils, my own remarks during this work being only suggestive as to mode of proceeding and including, where perfectly clear openings occur, such facts of physiology as their own experience can confirm. Then comes the examination of the bud structure. To study this I make use of the large terminal buds of the lilac. One of these is drawn entire. Then the scales are removed with appropriate instruments, some preferring needles, others forceps. The scales are laid out in four rows and numbered. (Flower buds are discarded for the present.) These rows of scales and evident inner leaves illustrate readily the relative position of these parts and the imperceptible transition from one to the other. What are the inner ones? Plainly leaves. When do they cease to be leaves? There is no boundary line, they must all be leaves. What is left of the bud? Only a little greenish pyramid. What is it? It must be a little short stem. What is seen on it with the lens? The places from which the leaves were taken—the leaf scars. On the old stem what name is given to the part bearing the scars or leaves? The joints, say some. Then what shall we call the part of the stem between such places? That's the joint, say others. We will call the former of these parts, nodes, and the latter internodes. This decision is approved because the terms are easy and the possible confusion is seen to be overcome.

Now, to each pupil is given a branch of a soft-stemmed fresh Eupatorium, taken from the green-house (Coleus is easily obtained and will answer the purpose.) The opposite decussate leaves are noted. With a sharp knife the internodes are cut away and the nodes, each with its pair of leaves attached, are laid on the table. The bud is now to be rebuilt. One of the dissecting needles, or very often a hat pin, is used, and the nodes with their attached leaves are spitted on to this. The leaves are then folded up carefully, beginning of course with the inner or uppermost pair; a light thread tied about them and the bud is reconstructed. Comparisons follow with pleasant and often very interesting comments, and a general feeling of good understanding prevails, which I believe even the myopic and mischievous correspondent to a late number of *St. Nicholas* might acknowledge to be of some worth. B. W. BARTON.

Baltimore.

Pressing plants.

The old-fashioned press has always seemed to me too slow in action and too bulky to give the best results or to be convenient. The "Acme" is nearer the true press for botanical work, but before I ever saw it I had made one upon the same plan, and have had most excellent results. My presses are made of slabs of hard wood (½ in. thick by 1 in. wide) tacked together so as to leave spaces a little over an inch square. Instead of straps I use four iron clamps with 2½ in. openings. I can press as many as 150 specimens of medium size in one of these presses, and under favorable conditions of wind and sun have the greater number of them dry and ready to take out in twenty-four hours, with the colors remarkably well preserved. I find the drying greatly hastened by the use of a piece of *black* cardboard or paper for the outside sheet. I always set my presses out in the hottest sunshine I can find, and turn them up so that the sun's rays will strike them at right angles. I have also found it better to multiply presses than to overcrowd one press. CHARLES A. DAVIS.

Alma College, Alma, Mich.

NOTES AND NEWS.

PROFESSOR A. A. WRIGHT, of Oberlin College, has published a very useful little pamphlet on "Herbarium-making."

Garden and Forest (May 14) contains the description and figure of the rare Buckleya distichopaylla, known only to occur at "Paint Rock," on the French Broad.

PARTS 39–43 of *Die natürlichen Pflanzenfamilien* have just appeared, and contain the first parts of *Compositæ*, by Hoffman; of *Euphorbiaceæ*, by Pax; and of *Conjugatæ*, by Wille.

A CATALOGUE of the grasses of the French possessions in China, by M. B. Balansa, is running serially in the *Journal de Botanique*. It contains the descriptions of many new species. With the April issue the number has reached 179.

Mr. W. A. SETCHELL has published a paper on the structure and development of *Tuomeya fluviatilis* Haw. It is a contribution from the cryptogamic laboratory of Harvard University, reprinted from the *Proc. Am. Acad.* A handsome folded plate and a dried specimen accompany the paper.

A VERY interesting address, commemorative of George W. Clinton, was delivered by David F. Day before the Buffalo Historical Society, March 24. It does not present the mere dry details of dates, but in style is a finished oration.

PAUL MAURY'S monograph of the Cyperaceæ of Paraguay includes 87 species, of which 18 are new. The largest genera are Cyperus (27 sp.), Eleocharis (16), and Rhynchospora (11), the great genus Carex being represented by only six species.

THE THIRD PAPER on North American Fungi, by A. P. Morgan, continues the order Lycoperdaceæ. The genera Tylostoma and Calvatia are presented, with a plate illustrating all the species of the former and two species of the latter. Five species of Tylostoma are described, two of which are new. Calvatia contains eleven species.

DR. DOUGLAS H. CAMPBELL, in *Bulletin of Torrey Botanical Club* (May), has given some interesting studies in cell-division, accompanied by two plates. It is not meant to be a contribution to our knowledge of the subject, but chiefly to call the attention of teachers of botany to the possibility of easily demonstrating this very important subject to their pupils.

THE PRESIDENTIAL ADDRESS of Prof. Lester F. Ward, before the Biological Society of Washington, on the "Course of Biologic Evolution," is a most excellent presentation of that law, the workings of which are so persistently and often wilfully misunderstood. Naturally, Professor Ward's illustrations are suggested by his work in paleobotany. It is printed by the society.

BOTANISTS should not fail to make their summer arrangements include a trip to Indianapolis during the meetings of the American Association, beginning August 19. Inspiration for work is always the result of such a gathering of botanists. Any who are out of the usual channels of information concerning rates, etc., can obtain such information by applying to any of the editors of this journal.

Dr. G. B. DE TONI has retired from the editorship of Notarisia, which will be issued hereafter by Dr. D. L. Morenos.

IN THE May number of the *Am. Month. Micro. Jour.* will be found a paper on "A Microscopic Study of the Cotton Plant."

A PORTRAIT and biographical sketch of Dr. C. C. Parry, by C. R. Orcutt, are published in the *West American Scientist* for June.

PROFESSOR L. H. BAILEY has just become editor of the *American Garden*. A more fitting selection could not have been made.

DR. SERENO WATSON has been elected a foreign member of the Linnæan Society. As the number of foreign members is small, the honor is correspondingly great.

PROFESSOR OLIVER has resigned his position as curator of the herbarium at Kew. He has been connected with the herbarium for about thirty years, and will continue to reside at Kew.

DR. MIGULA, who is preparing the *Characeæ* for Rabenhorst's "Kryptogamen-Flora," insists upon their isolated position in the vegetable kingdom, proposing the name *Charophyta* for the group, which contains about 150 species in the whole world.

IN *Pittonia* (ii. 82–90), Dr. C. F. Millspaugh makes a second contribution to our knowledge of N. Am. Euphorbiaceæ. The puzzling E. serpyllifolia and its forms are discussed, and presented in a plate. New species are described from Idaho, Arizona, and Texas.

IN BALANSA'S catalogue of Chinese grasses, being published in the *Journal de Botanique*, the current and last installment (May 1) contains descriptions of two new genera, *Brousemichea* (Agrostideæ) and Massia (Aveneæ), and several new species. The complete catalogue contains 235 numbers.

IN *Zo*, for May, Dr. Harkness gives another list of generic names common to Durand and Saccardo. This list contains 15 genera, and is in addition to a former list published in *Bull. Cal. Acad.* i. 176. Only those names are included which are accepted in these great works on Phanerogams and Fungi. We note in the list the American genera Cladothrix and Tipularia.

THE usual summer school of botany of Harvard University will be conducted this year by Mr. F. W. Ganong, instructor in botany in the college, assisted by Mr. G. J. Pierce, of the Lawrence Scientific School. Mr. A. B. Seymour, assistant in the cryptogamic herbarium, also announces a private class in cryptogamic botany, beginning and closing at the same time. The session this year is from July 2 to July 30.

THE NAMING of mosses by the use of the manual of Lesquereux & James alone has been found to be most difficult by amateurs who have no other aid. Professor Charles R. Barnes has just issued a 72-page pamphlet containing analytic keys to the genera and species of N. Am. mosses. These keys, on the general plan of those in Gray's Manual, will enable students and collectors of mosses, with comparatively little experience, to name correctly most of the species they can collect. A commendable feature of this pamphlet, which is to be frequently consulted, is that it is sewed, not stitched, so as to lie open flat. Single copies can be obtained from the author, at Madison, Wis., for 50 cents.

MRS. E. G. BRITTON has begun to issue from the herbarium of Columbia College sets of the mosses collected by Mr. J. B. Leiberg in northern Idaho and adjacent regions. The first issue comprises 40 species, the majority characteristically western, among which the most noteworthy are the new Hypnum (Thamnium) Leibergii and a striking flagellate form (or perhaps a variety) of Alsia abietina. All the specimens are beautifully prepared and supplied with printed labels. Most of the sets will be sent to the larger herbaria, but a few are for sale at the rate of 5 cents per species. In contrast with the only American mosses which have been recently offered for sale, Macoun's Canadian Musci, the neatness, and particularly the accuracy of the labelling, and the low price are noteworthy.

A PROVISIONAL LIST of the plants of the Bahama Islands has been published in Proc. Philad. Acad. for 1889 (pp 349–426). It is arranged for publication (with notes and additions) by Dr. C. S. Dolley, of the Univ. of Penn., but the body of the list is credited to Professor John Gardiner, of the Univ. of Colorado, and L. J. K. Brace, of the Botanical Gardens at Calcutta. It is somewhat refreshing to see the lowest groups presented first and the dicotyledons appearing last. It appears that fully a third of the species may be considered indigenous, the remaining species being in common with Florida and the near lying islands of the West Indies. The list contains 115 families, 410 genera, and 621 species. A third of the families are represented by but one or two species each, another third by 5 species or less; while nearly two-thirds of the genera have but one species. Nearly a third of the species are of economic value. The families are grouped as follows in the order of their importance: Leguminosæ (53 sp.), Euphorbiaceæ (35), Compositæ (32), Gramineæ (32), Rubiaceæ (23), Malvaceæ (18). The largest genera are Croton, Epidendron, Euphorbia, and Passiflora, with 8 species each.

THE FOLLOWING comment upon the *Buda* and *Tissa* question, by James Britten, editor of the *Journal of Botany* (London), may be of interest to some: "I have abstained from comment on certain eccentricities of the neo-American school of nomenclature, because I was not willing to occupy the limited space of the *Journal* by again calling attention to the mischievous tendency of innovations which have been already sufficiently exposed. But, as the question of priority connected with the above synonyms of Spergularia affects the naming of British plants, it may be well to call attention to the grounds on which Buda (revived by Dumortier in 1827) is superseded by Tissa (revived by Prof. E. L. Greene in 1888)." The writer then quotes from the GAZETTE review of the new Manual by Dr. Trelease (xv. 73) what is there said in reference to Buda and Tissa, and proceeds as follows: "As I have already pointed out in this *Journal* the two names occur *on the same page* of Adanson's 'Famille des Plantes,' so that the 'birthright' of the two is equal, and neither can claim priority; while the objectionable 'increase in the number of synonyms' is due, not to Dr. Watson, but to Dr. Britton, who deliberately ignored Dumortier's restoration, sixty years before, of a name having equal claims with that preferred by himself."—*Journal of Botany*, for May.